DOCUMENTATION OF ENVIRONMENTAL INDICATOR DETERMINATION

RCRA Corrective Action
Environmental Indicator (EI) RCRIS code (CA725)

Current Human Exposures Under Control

Facility Name: BP/Prudhoe Bay
Facility Address: Deadhorse, AK
Mailing Address: 900 E. Benson Boulevard
Anchorage, Alaska 99519-6612

Facility EPA ID #: AKD 00064 3239

1. Has all available relevant/significant information on known and reasonably suspected releases to soil, groundwater, surface water/sediments, and air, subject to RCRA Corrective Action (e.g., from Solid Waste Management Units (SWMU), Regulated Units (RU), and Areas of Concern (AOC)), been considered in this EI determination?

__X__ If yes - check here and continue with #2 below.

_____ If no - re-evaluate existing data, or

_____ If data are not available skip to #6 and enter "IN" (more information needed) status code.

BACKGROUND

Definition of Environmental Indicators (for the RCRA Corrective Action)

Environmental Indicators (EI) are measures being used by the RCRA Corrective Action program to go beyond programmatic activity measures (e.g., reports received and approved, etc.) to track changes in the quality of the environment. The two EI developed to-date indicate the quality of the environment in relation to current human exposures to contamination and the migration of contaminated groundwater. An EI for non-human (ecological) receptors is intended to be developed in the future.

Definition of "Current Human Exposures Under Control" EI

A positive "Current Human Exposures Under Control" EI determination ("YE" status code) indicates that there are no "unacceptable" human exposures to "contamination" (i.e., contaminants in concentrations in excess of appropriate risk-based levels) that can be reasonably expected under current land- and groundwater-use conditions (for all "contamination" subject to RCRA corrective action at or from the identified facility (i.e., site-wide)).

Relationship of EI to Final Remedies

While Final remedies remain the long-term objective of the RCRA Corrective Action program the EI are near-term objectives which are currently being used as Program measures for the Government Performance and Results Act of 1993, GPRA). The "Current Human Exposures Under Control" EI are for reasonably expected human exposures under current land- and groundwater-use conditions ONLY, and do not consider potential future land- or groundwater-use conditions or ecological receptors. The RCRA Corrective Action program's overall mission to protect human health and the environment requires that Final remedies address these issues (i.e., potential future human exposure scenarios, future land and groundwater uses, and ecological receptors).

Duration / Applicability of EI Determinations

EI Determinations status codes should remain in RCRIS national database ONLY as long as they remain true (i.e., RCRIS status codes must be changed when the regulatory authorities become aware of contrary information).

2. Are groundwater, soil, surface water, sediments, or air media known or reasonably suspected to be "contaminated"[1] above appropriately protective risk-based "levels" (applicable promulgated standards, as well as other appropriate standards, guidelines, guidance, or criteria) from releases subject to RCRA Corrective Action (from SWMUs, RUs or AOCs)?

	Yes	No	?	Rationale / Key Contaminants
Groundwater	X			see below
Air (indoors)[2]		X		
Surface Soil(e.g., <2 ft)	X			see below
Surface Water	X			see below
Sediment		X		
Subsurf. Soil(e.g.,>2 ft)	X			see below
Air (outdoors)		X		see below

_____ If no (for all media) - skip to #6, and enter "YE," status code after providing or citing appropriate "levels," and referencing sufficient supporting documentation demonstrating that these "levels" are not exceeded.

__X__ If yes (for any media) - continue after identifying key contaminants in each "contaminated" medium, citing appropriate "levels" (or provide an explanation for the determination that the medium could pose an unacceptable risk), and referencing supporting documentation.

_____ If unknown (for any media) - skip to #6 and enter "IN" status code.

[1] "Contamination" and "contaminated" describes media containing contaminants (in any form, NAPL and/or dissolved, vapors, or solids, that are subject to RCRA) in concentrations in excess of appropriately protective risk-based "levels" (for the media, that identify risks within the acceptable risk range).

[2] Recent evidence (from the Colorado Dept. of Public Health and Environment, and others) suggest that unacceptable indoor air concentrations are more common in structures above groundwater with volatile contaminants than previously believed. This is a rapidly developing field and reviewers are encouraged to look to the latest guidance for the appropriate methods and scale of demonstration necessary to be reasonably certain that indoor air (in structures located above (and adjacent to) groundwater with volatile contaminants) does not present unacceptable risks.

Rationale and Reference(s):

The following information, as well as supplemental information such as specific constituent levels, can be found in the documents cited at the end of this section. These documents are available in the Region 10 RCRA files.

Facility Description

BP/Prudhoe Bay is an oil and gas production facility located on the North Slope of Alaska. Petroleum exploration in the Arctic began in the 1920s. Oil was discovered at Prudhoe Bay in 1968.

The oil field opened for large scale development with the completion of the Trans-Alaska Pipeline in 1977. The Prudhoe Bay oil field is operated by BP and is situated on state-owned land which is leased and managed by the Alaska Department of Natural Resources. Oil production is ongoing at the facility. Production fluids (oil, gas, and water) are extracted from the wells and are separated in processing plants. Oil is routed to the Trans-Alaska Pipeline System. Produced water is re-injected into the formation to help maintain reservoir pressure and enhance further oil recovery. The gas is sent down the pipeline with the crude oil (natural gas liquids), injected into the gas cap for enhanced oil recovery, or used for local fuel.

The North Slope of Alaska is isolated and very sparsely populated. The Prudhoe Bay facility is approximately 388 square miles in area. The nearest residential area is the Alaskan Native Village of Nuiqsut, which is 60 miles west of Prudhoe Bay. The Arctic location of this site greatly impacts facility operations as well as waste management and corrective action. Transportation can be difficult. The area is classified as Arctic desert, cold and dry. Permafrost underlies the site to a depth of approximately 2000 feet. All structures (buildings, roads, production wells, etc.) must be built on 5 or more feet of gravel to prevent thawing of the ground and settling. The active zone (up to three feet below ground surface) thaws briefly each summer. There is very low topographic relief and numerous shallow lakes form seasonally on the tundra. There are 56 days of darkness in midwinter. The ecosystem is acutely fragile.

A comprehensive RCRA corrective action 3008(h) Order Under Consent (Order) was issued for the facility in October, 2007. A standardized RCRA permit was issued in 2009. The Order requires submission of multiple RCRA Facility Investigation (RFI), Interim Measure (IM), Corrective Measure Study (CMS), and Corrective Measure Implementation (CMI) work plans and reports, as well as several other documents. RCRA corrective action work at the facility is anticipated to continue throughout the life of the oil field.

The Order has identified more than two thousand (2000) solid waste management units (SWMUs). For management purposes only, these have been broken down into 10 categories: Inactive Production Reserve Pits; Inactive Exploration Sites; Inactive Oily Waste Cells, Tuboscope; Alaska Charter Sites; Non Charter Sites; Old Landfill Sites; Other Inactive Impoundments; Active Operational Sites Where Releases May Have Occurred (well cellars, flare pits, relief pits, etc); and Other Active Operation Sites (Solid Waste Cells). There have been releases from some of these SWMUs which have resulted in exceedences of both the Tier I Site Screening Levels and the proposed Tier II Action Levels in groundwater, surface water and soils at the facility (see *Site-Wide Project Work Plan – Part III, Revised Site-Wide Conceptual Site Model and Screening Levels*.) Interim clean up activities have included pump and treat; removal; and treatability studies involving nanotechnology (nZVI) and bioremediation.

Groundwater

Groundwater at the BP/Prudhoe Bay facility is largely limited to the top 18 – 36 inches below ground surface due to the underlying permafrost. This suprapermafrost groundwater is frozen eight to nine months of the year. There is very little topographic relief at the facility. Compared to sites in more temperate climates, contaminant migration is relatively limited, both horizontally and vertically. In the wetter areas of the facility, the groundwater is highly interconnected to the many small ponds and marshy areas that form on the tundra in the summer.

Samples have shown that some groundwater at the facility contains contaminants in excess of the Tier I Screening Levels and the proposed Tier II Actions Levels. Contaminants that have been identified as exceeding the proposed Tier II levels include: BTEX compounds, chlorinated solvents, methanol, 1,4-Dioxane, naphthalenes, polycyclic aromatic hydrocarbons (PAHs), and metals.

Surface Water

The Prudhoe Bay facility is immediately adjacent to Prudhoe Bay and the Beaufort Sea. Three rivers (Kuparuk River, Putuligayuk River, and the Sagavanirktok River) transect the facility, from south to north. There are three lakes which are deep enough that they do not freeze completely to the bottom in the winter. In the summer, much of the facility is covered with small ponds and marshy tundra. Some areas, especially in the western part of the facility, are drier with fewer small ponds. While some small ponds/marshy areas of tundra have been impacted by releases, there are no known ongoing releases to the large lakes, or the sea. There is currently insufficient data to determine if constituents have reached the Sagavanirktok River. Upgradient groundwater samples contain low levels of constituents (one PAH, metals). Sediment/river samples in the area were not contaminated.

Samples have shown that some surface water features near SWMUs at the facility contain contaminants in excess of the Tier I Screening Levels and the proposed Tier II Actions Levels. Contaminants in the small ponds/tundra marshy areas that have been identified as exceeding the proposed Tier II levels include: chlorinated solvents, 1,4-Dioxane, and metals.

Surface Soil/Subsurface Soil/Pad Gravel

Vertical migration of contaminants in the soil is limited by the presence of permafrost.

Samples have shown that surface soils, subsurface soils and pad gravel at the facility contain contaminants in excess of the soil Tier I Screening Levels and the proposed Tier II Actions Levels. Contaminants that have been identified as exceeding the proposed Tier II levels include: BTEX compounds, chlorinated solvents, naphthalenes, methanol, formaldehyde, PAHs, and metals.

Outdoor Air

Outdoor Air sampling results have not been reported or required for this facility. Outdoor air contaminants from RCRA activities are not reasonably suspected to exceed risk-based levels.

Supporting Documentation

Administrative Order on Consent, EPA Docket No.: RCRA-10-2007-0222, In the Matter of: BP Exploration (Alaska) Inc., Prudhoe Bay, Alaska, 99744, #AKD 00064 3239. United States Environmental Protection Agency Region 10. October 3, 2007.

2012 RCRA Annual Report, Prudhoe Bay Facility, Alaska, Administrative Order on Consent: RCRA-10-2007-0222. Hobbit Environmental (Prepared for BPXA). March 29, 2013. [Also: Annual Reports for 2008 – 2011]

2012 Field Season Water Treatment System Progress Report, Former Tuboscope Site, Administrative Order on Consent EPA Docket No.RCRA-10-99-0179, OASIS Environmental (prepared for BPXA). November 13, 2012.

Site-Wide Project Work Plan – Part I; Part 1: Site-wide Background Report, Prudhoe Bay Facility, Alaska. OASIS Environmental (prepared for BPXA). January 28, 2008

Site-Wide Project Work Plan – Part I; Part 2: Current Conditions Report, Prudhoe Bay Facility, Alaska. OASIS Environmental (prepared for BPXA). January 28, 2008

Site-Wide Project Work Plan – Part III, Revised Site-Wide Conceptual Site Model and Screening Levels, Prudhoe Bay Unit; Prudhoe Bay Facility, Alaska, Administrative Order on Consent, RCRA-10-2007-0222. SLR (prepared for BPXA). August, 2011.

RCRA Facility Investigation Interim Summary Report, Former Tuboscope Site, Administrative Order on Consent RCRA-10-2007-0222. OASIS Environmental (prepared for BPXA). July 2012.

RCRA Facility Investigation 2012 Interim Summary Report, Former Sand Dunes Landfill, Administrative Order on Consent RCRA-10-2007-0222. ERM (prepared for BPXA). April 2013.

RCRA Facility Investigation 2012 Interim Summary Report, Former Pad 13 Waste Pile, Administrative Order on Consent RCRA-10-2007-0222. ERM (prepared for BPXA). April 2013.

3. Are there complete pathways between "contamination" and human receptors such that exposures can be reasonably expected under the current (land- and groundwater-use) conditions?

Summary Exposure Pathway Evaluation Table

Potential **Human Receptors** (Under Current Conditions)

Contaminated Media	Residents	Workers	Day Care	Construction	Trespassers	Recreation	Food[3]
Groundwater	-	no	-	yes	-	-	no
~~Air (indoors)~~	-	-	-	-	-	-	-
Soil (surface, e.g., <2ft.)	-	yes	-	yes	-	-	yes
Surface Water	-	yes	-	yes	-	-	yes
Soil (subsurface e.g., >2 ft)	-	no	-	yes	-	-	no
~~Air (outdoors)~~	-	-	-	-	-	-	-

[3] Indirect Pathway/Receptor (e.g., vegetables, fruits, crops, meat and dairy products, fish, shellfish, etc.)

Instructions for Summary Exposure Pathway Evaluation Table:

1. Strike-out specific Media including Human Receptors' spaces for Media which are not "contaminated") as identified in #2 above.
2. enter "yes" or "no" for potential "completeness" under each "Contaminated" Media -- Human Receptor combination (Pathway).

Note: In order to focus the evaluation to the most probable combinations some potential "Contaminated" Media - Human Receptor combinations (Pathways) do not have check spaces ("___"). While these combinations may not be probable in most situations they may be possible in some settings and should be added as necessary.

____ If no (pathways are not complete for any contaminated media-receptor combination) - skip to #6, and enter "YE" status code, after explaining and/or referencing condition(s) in-place, whether natural or man-made, preventing a complete exposure pathway from each contaminated medium (e.g., use optional Pathway Evaluation Work Sheet to analyze major pathways).

__X__ If yes (pathways are complete for any "Contaminated" Media - Human Receptor combination) - continue after providing supporting explanation.

____ If unknown (for any "Contaminated" Media - Human Receptor combination) - skip to #6 and enter "IN" status code

Rationale and Reference(s):

Pathways

Residences: No pathways are currently complete to residential receptors. There are currently no residential areas at the facility, adjacent to the facility, or above contaminated groundwater. Workers travel to the facility and stay in dormitory style housing. The most common shift is two weeks on, two weeks off. There are no outdoor activities (e.g. landscaping, gardening, picnicking) similar to outdoor residential activities. There are no children at the facility, except for rare brief visits. Long-term residents are unlikely to live at the facility while the oil field remains active.

Workers: Workers at the facility may be exposed to contaminated surface soils/gravel pads or surface water. Exposure to surface soils or surface water is very limited. Workers at Prudhoe Bay are prohibited from walking on the tundra except on snow cover. Special permission must be obtained for off pad work.

Day Care: No pathways are complete to day care centers. There are no day cares at the facility or nearby. No children live at or near the facility and they are only allowed to visit infrequently.

Construction: Construction and remediation activities at the facility or nearby may expose workers to contaminants in groundwater, surface water, surface soils, and subsurface soils.

Trespassers: No pathways are complete to trespassers. The BP/Prudhoe Bay facility is isolated and difficult to reach. Facility security is very controlled due to the nature of the business and homeland security concerns.

Recreation: No pathways are complete to recreational users. Workers rarely fish in the rivers crossing the facility. Additionally, there are no known releases that have impacted the current water quality or biota.

Food: There may be minimal subsistence activity at the facility boundary (shoreline) with potentially complete exposure pathways.

4. **Can the exposures from any of the complete pathways identified in #3 be reasonably expected to be "significant"[4] (i.e., potentially "unacceptable" because exposures can be reasonably expected to be: 1) greater in magnitude (intensity, frequency and/or duration) than assumed in the derivation of the acceptable "levels" (used to identify the "contamination"); or 2) the combination of exposure magnitude (perhaps even though low) and contaminant concentrations (which may be substantially above the acceptable "levels") could result in greater than acceptable risks)?**

__x__ If no (exposures cannot be reasonably expected to be significant (i.e., potentially "unacceptable") for any complete exposure pathway) - skip to #6 and enter "YE" status code after explaining and/or referencing documentation justifying why the exposures (from each of the complete pathways) to "contamination" (identified in #3) are not expected to be "significant."

____ If yes (exposures could be reasonably expected to be "significant" (i.e., potentially "unacceptable") for any complete exposure pathway) - continue after providing a description (of each potentially "unacceptable" exposure pathway) and explaining and/or referencing documentation justifying why the exposures (from each of the remaining complete pathways) to "contamination" (identified in #3) are not expected to be "significant."

____ If unknown (for any complete pathway) - skip to #6 and enter "IN" status code

[4] If there is any question on whether the identified exposures are "significant" (i.e., potentially "unacceptable") consult a human health Risk Assessment specialist with appropriate education, training and experience.

Rationale and Reference(s):

Complete Pathways/Significance of Exposure

Workers: The BP/Prudhoe Bay facility has a robust health and safety program which educates facility workers and monitors worker safety. Direct exposure to workers from surface soils and surface water is not significant because workers are not allowed off pad in the summer without express permission. Other than investigation and remediation work, there is generally no reason for workers to be off pad in areas that have contamination. Direct exposure to workers from pad gravel is not significant. There is no exposure pathway from gravel pads most of the year when the pads are frozen and snow covered. In the summer months, the main exposure routes are dermal and ingestion of dust. In general, there is no reason for workers to be in contact with the gravel pad. Digging without a permit is not allowed. Dust on the pads is limited. Wind borne dust from pads is rare as the gravel surface is hard packed, is often wet even in the summer, and vehicles are restricted to low speed on the pads. The pad areas which have surface contamination are small relative to the area of the facility and, with few exceptions, are in not in areas which are widely accessed. Exposure of workers from specialized areas of the gravel pads (reserve pits/well cellars/flare pits/fire training grounds, etc.) is also not significant. Only workers trained and protected, as necessary, to work in these areas enter them.

Construction/Remediation: All construction activities at the facility require a permit. The permitting process informs construction workers of any potential hazards/contamination. Construction workers exposed to RCRA contamination are likely to be exposed for such a short duration that the exposure would not be significant, based on the general concentration levels of site

contaminants. Additionally, the facility's health and safety program ensures that OSHA standards are not exceeded. Workers engaged in remediation activities at the facility have been trained in health and safety practices and briefed on site-specific issues. Appropriate levels of protection are used. Exposures for remediation workers are of short duration.

Food: Subsistence use across the site was present in the past and may resume at some time in the future after active oil production ceases. Current subsistence use at the site is minimal to nonexistent and is limited to opportunistic hunting of caribou or waterfowl along a very narrow strip of coastline during whaling trips. Any such exposure would not be significant because: 1) it would be a rare occurrence and 2) any animal taken is unlikely to have significant amounts of contamination because they are transient/seasonally present and because the areas from which they might intake contamination are very small relative to the area in which they forage. Whaling, fishing, and hunting take place in the adjacent Beaufort Sea, but there have been no known releases that would have impacted the biota in the sea. No hunting is currently allowed within the facility boundary. Fishing in rivers (see recreation, above) is minimal. There is no current subsistence fishing in the rivers.

5 Can the "significant" exposures (identified in #4) be shown to be within acceptable limits?

____ If yes (all "significant" exposures have been shown to be within acceptable limits) - continue and enter "YE" after summarizing and referencing documentation justifying why all "significant" exposures to "contamination" are within acceptable limits (e.g., a site-specific Human Health Risk Assessment).

____ If no (there are current exposures that can be reasonably expected to be "unacceptable")- continue and enter "NO" status code after providing a description of each potentially "unacceptable" exposure.

____ If unknown (for any potentially "unacceptable" exposure) - continue and enter "IN" status code

Rationale and Reference(s):

Check the appropriate RCRIS status codes for the Current Human Exposures Under Control EI event code (CA725), and obtain Supervisor (or appropriate Manager) signature and date on the EI determination below (and attach appropriate supporting documentation as well as a map of the facility):

__x__ YE - Yes, "Current Human Exposures Under Control" has been verified. Based on a review of the information contained in this EI Determination, "Current Human Exposures" are expected to be "Under Control" at the BP/Prudhoe Bay facility, EPA ID #AKD 00064 3239, located near Deadhorse, Alaska, under current and reasonably expected conditions. This determination will be re-evaluated when the Agency/State becomes aware of significant changes at the facility.

____ NO - "Current Human Exposures" are NOT "Under Control."

____ IN - More information is needed to make a determination.

Completed by _____

Date 9/11/13

Robbie Hedeen
Environmental Scientist

Supervisor _____

Date 9/11/13

Kate Kelly
Director, Office of Air, Waste and Toxics
EPA, Region 10

Locations where References may be found:

RCRA Facility Files
U.S. EPA Region 10
1200 Sixth Avenue, AWT-121
Seattle, WA 98101

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FINAL NOTE: THE HUMAN EXPOSURES EI IS A QUALITATIVE SCREENING OF EXPOSURES AND THE DETERMINATIONS WITHIN THIS DOCUMENT SHOULD NOT BE USED AS THE SOLE BASIS FOR RESTRICTING THE SCOPE OF MORE DETAILED (E.G., SITE-SPECIFIC) ASSESSMENTS OF RISK.